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Chaetomium and Stachybotrys from water-damaged buildings



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Introduction

Fungal growth occurs when parts of the building envelope get very wet due to unfortunate combinations of factors, e.g. thermal bridges/lack of ventilation, shoddy foundations/flooding or leaks in build-in pipes.

Chaetomium and *Stachybotrys* are not as abundant as *Penicillium* and *Aspergillus* (Table 1), however, they may produce volatiles and micro-particles that can cause health problems. They are common in wet walls constructed of wood fibre board (OSB/plywood) and gypsum board.

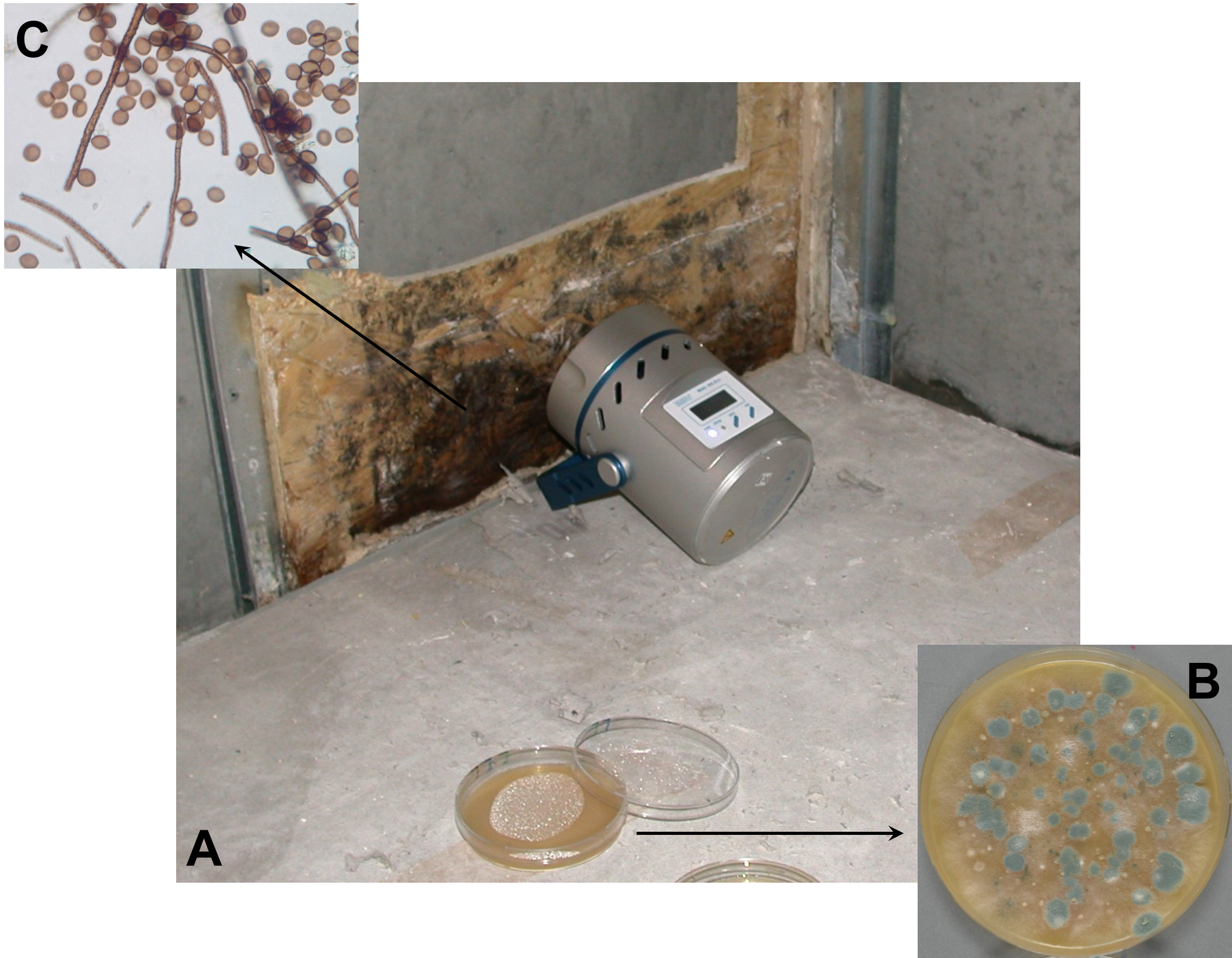


Figure 1. Mouldy wall construction (A). Volumetric air sampling on V8 agar (B) after removal of gypsum board yielded only *Penicillium*, while a tape preparation (C) revealed *Chaetomium*.

Materials & Methods

Sampling: Air sampling and Q-tip swabs onto V8-juice agar

Identification: Tape preparation/microscopy from materials and agar

Metabolites: AcN/H₂O extraction and Q-TOF LC-MS/MS-MS

Fungal growth: Biolog FF® plates/stereo microscope

Carbohydrates: H₂O extraction, trimethylsilylation and GC-MS

Table 1. Frequency (%) and associations (%) of *Chaetomium* and *Stachybotrys* in buildings in DK.

Overall frequency	Fungal species	Wood work	Chip wood	Gypsum	Wallpaper
39.7	<i>Penicillium</i> spp.	15	4	14	5
15.6	<i>Aspergillus versicolor</i>	10	1	4	7
3.1	<i>Chaetomium globosum</i>	18	2	9	2
1.9	<i>Stachybotrys chartarum</i>	7	0	39	8

Modified from Andersen et al. 2011 Appl. Environ. Microbiol. 77: 4180–4188.

Results & Conclusions

- Air sampling of *Chaetomium* and *Stachybotrys* is not reliable due to spores located in either perithecia or slime heads (Figure 1) and their lack of viability
- Both *Chaetomium* and *Stachybotrys* can produce a wide array of metabolites on naturally infected building materials (Table 2)
- Creation of a chemical library for automated dereplication of *Chaetomium* and *Stachybotrys* metabolites in mouldy building materials
- Stachybotrys* and especially *Chaetomium* can utilize a variety of small carbohydrates and amino acids (Table 3)
- Building materials (a range of wood fibre boards and the cardboard on gypsum board) already contain several carbohydrates (Table 3) and nitrogen sources, e.g. urea

Table 2. Metabolites detected on new, non-inoculated material samples incubated at 80 % RH for 3 months.

Fungal metabolite	OSB + paper	OSB + wood fibre	OSB+ glass fibre	Gypsum + paper	Gypsum + wood fibre	Gypsum + glass fibre
Chaetoglobosins A + B + C	+	+	+	+	-	-
Chaetomugilin	+	+	+	+	+	+
Chaetoviridins	+	+	+	+	+	-
Cochliodons	-	-	-	-	+	+
Dihydrochaetoglobosin A	-	-	+	-	-	-
Prochaetoglobosins I + III + IV	+	+	+	+	-	+
Chartarlactames	-	-	-	-	+	+
F-1839-E	-	-	+	+	+	+
Spirodihydrobenzofuranlactame V	-	-	+	-	-	-

Chaetomium metabolites in **black** and *Stachybotrys* metabolites in **red**

Table 3. Fungal growth on various carbohydrates and their presence in new material samples directly from the DIY retailer.

Fungal growth and sporulation		Carbohydrates	Carbohydrates detected in new, fungal free building materials					
<i>Chaetomium</i> (2)	<i>Stachybotrys</i> (2)		Wallpaper (1)	Gypsum (4)	Chip wood (4)	OSB (1)	Plywood (1)	Masonite (1)
M	M	Glucose*	-	+	+	+	-	+
- ^a	-	Galactose*	-	+	(+)	-	-	-
M	M	Ribose	+	(+)	+	-	-	+
P	M	Glycerol	+	(+)	(+)	-	+	+
P	M	Sorbitol	-	(+)	-	+	-	-
P	M	Gluconic acid	-	(+)	-	-	-	-
P	M	Inositol	-	-	+	+	-	+
M	-	Arabitol	-	-	(+)	+	-	-
P	S	Xylose*	-	-	-	-	-	+
P	S	Malic acid	-	-	-	-	+	-
M	S	Lactic acid	-	-	-	-	-	+
P	S	α-Keto glutaric acid	-	-	-	-	-	-
P	S	β-Hydroxy butyric acid	-	-	-	-	-	-
M	S	Fumaric acid	-	-	-	-	-	-
M	M	Glucuronic acid*	-	-	-	-	-	-
M	-	Arabinose*	-	-	-	-	-	-
M	-	Cellobiose*	-	-	-	-	-	-
nt	nt	Urea (nitrogen source)	-	-	(+)	+	-	-

Fungal growth and sporulation: **M:** mycelium produced; **P:** perithecia produced; **S:** spores produced. ^aNo growth. (Number of strains or samples).

* Carbohydrates relating to lignocellulosic materials, e.g. wood fibre boards and cardboard. Compounds in **red** are common in building materials.

Ongoing & new projects

- Germination times of *Chaetomium* and *Stachybotrys* spores on different lignocellulosic materials, a_w-values and temperatures
- Novel DNA barcodes for detection of *Chaetomium* and *Stachybotrys* in contaminated buildings
- Methods to detect *Chaetomium* and *Stachybotrys* metabolites and micro-particles directly in indoor air
- Contamination sources of *Chaetomium* and *Stachybotrys* and their origin
- Methods to make lignocellulosic building materials less susceptible to fungal growth

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